Indian Statistical Institute, Bangalore
M.S (QMS) First Year

Second Semester – Advanced Statistical Process Control

Mid-Semester Exam Duration: 2hrs Date: 02nd March 2015 Max Marks: 50

1. A machine is used to product different part numbers with same tolerance but different targets as per the following sequence (in a given day)

   Part no.1 – 25 parts
   Part no.2 – 20 parts
   Part no.3 – 10 parts
   Part no.4 – 15 parts

   The product characteristic of interest is a measurable one. Develop a suitable control chart mechanism for process control for the same. [10]

2. Suggest suitable process control system (tool) for each process described below:- [8]

SL No.	Process characteristic/behavior	Product characteristic
A	The quality of the product largely depends on the operator attentiveness and skill	Discrete
B	In a manufacturing process, the machine including the tool(s) to be set properly by the engineer. One set, the process is capable of producing parts for a reasonable period of time.	Continuous
C	Product quality depends on the quality of the raw materials used for manufacturing. The raw material suffers from natural variation.	Continuous
D	A very capable process is used to produce a critical part. Every time the part is produced, the engineer adjusts the machine for the part, before start of production.	Continuous

3. One injection monitoring machine is used to manufacture different plastic components. The date given below the number of parts inspected (hourly) and the number of defeats observed in them for last few days. Develop a suitable control chart for the process. [10]

Date	Part No.	No. of Parts checked	No. of Defects Observed
04.02.15	A	80	4
04.02.15	A	110	7
04.02.15	A	90	5
05.02.15	B	75	8
05.02.15	B	130	6
05.02.15	B	120	7
05.02.15	C	70	4
06.02.15	A	125	6
06.02.15	A	100	8
06.02.15	B	135	9

4. A continuous product characteristic is normally distributed and the natural (μ ± 3 σ) variation of the process exactly coincides with the tolerance. Calculate the probability of each event as defined in the pre-control chart below? [6]
   i) Point outside specification.
   ii) 2 consecutive points outside pre-control limit by within specification.
   iii) 5 consecutive points within pre-control limit

5. Data were collected from packing process. The packing machine has 4 heads, from which products are continuous being packed. Data collected on hourly basis on filled weight is shown below: [4+10]

Time	1		2		3		4	
	$\bar{x}_i$	R_i	$\bar{x}_i$	R_i	$\bar{x}_i$	R_i	$\bar{x}_i$	R_i
1	38	4	39	3	38	2	38	4
2	40	2	40	1	39	3	38	3
3	39	5	41	2	40	2	40	4
4	40	3	41	4	38	4	39	3
5	41	4	40	3	39	3	42	4
6	40	3	41	1	38	2	38	2
7	42	1	40	3	40	3	39	4
8	40	3	39	1	38	1	38	4
9	41	2	38	1	41	2	41	2
10	37	3	38	4	40	3	39	4

   a) State the condition to be checked before calculating the control chart?
   b) Develop a suitable control chart. Comment about the process and suggest future control.

6. A product has 2 quality characteristics. Data collected on them shows the following:

$$\bar{x} = \begin{bmatrix} 3.0 \\ 2.8 \end{bmatrix} \qquad S = \begin{bmatrix} 1.41 & 1.03 \\ 1.24 & 1.36 \end{bmatrix}$$

   This data were collected by using a subgroup of 10 pieces for 15 such subgroups. Does the process appear to be in statistical control? [12]